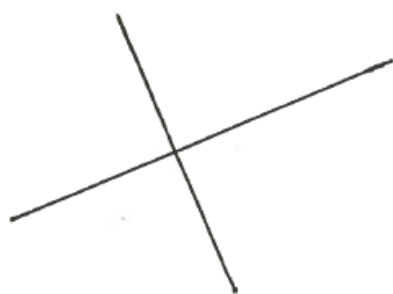


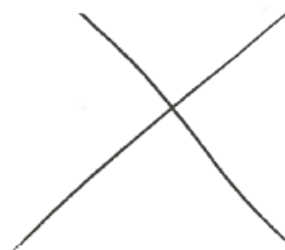
Welcome to calculus in higher dimensions! In our previous studies in calculus we examined change in the context of a single variable. This involved developing our understanding how infinitesimal change with respect to a single independent variable affected its relationship with a dependent variable. Now we attempt to expand our knowledge by investigating if we can generalize our ideas from working with a single variable to multiple variables. To begin we will first focus on developing our ability to create and interpret objects in 3-space.

Tips for Drawing 3D-Objects

1. Have a “straight” edge handy, or deal with poor “lines”

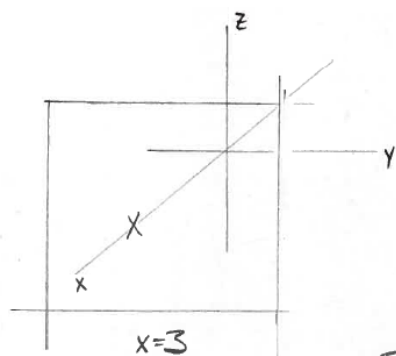


AWESOME!



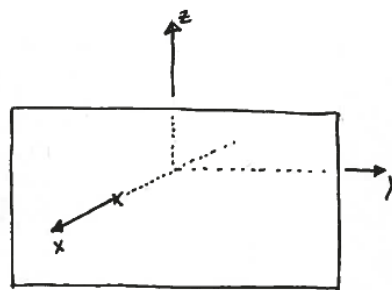
NOT GREAT

2. Use both pencil and pen. Colors may be useful. You will inevitably inevitably make mistakes, or decide to “adjust” something. We will also need to use “reference lines” to draw excellent objects, but they *should not* be in the final picture.



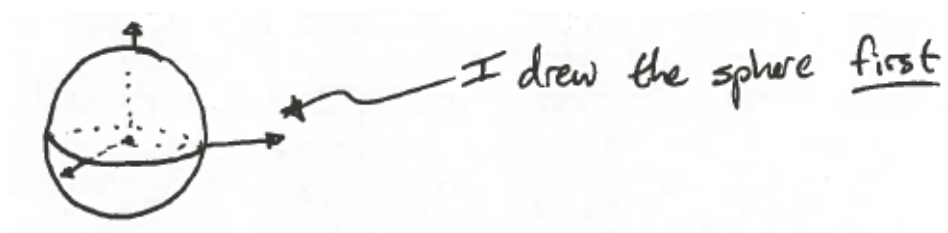
Draw this first

ERASE
and emphasize

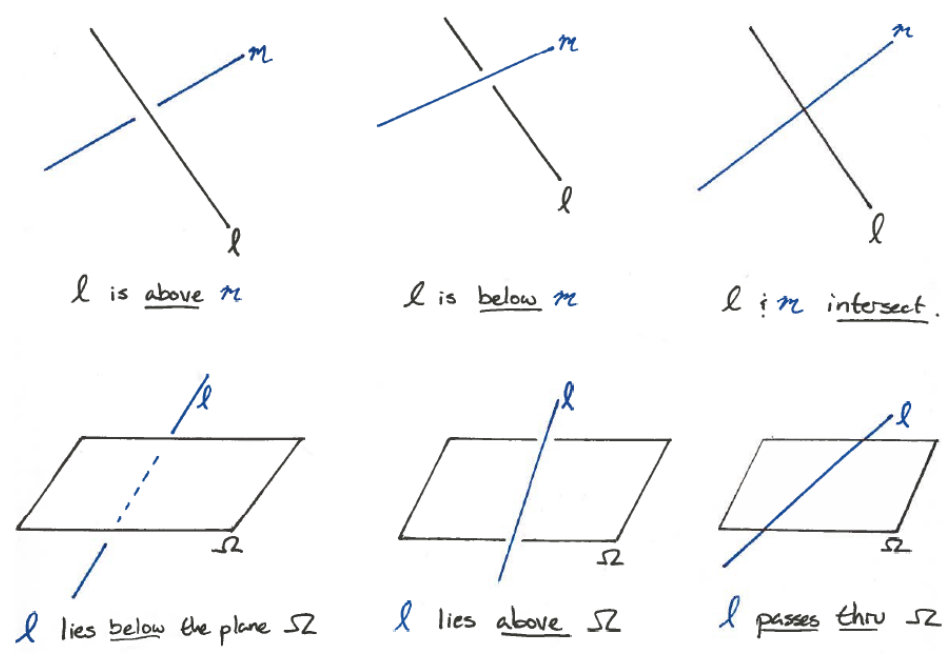


The plane $x=3$

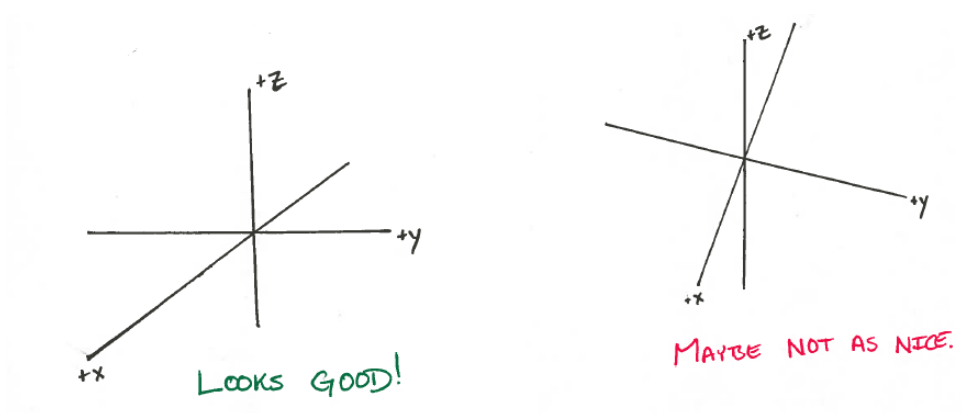
3. The *shape* and *relations* are what matter. Some find it useful to draw the *objects*, rather than the axes, first. To this end, draw objects as though they are far away and down to the left.



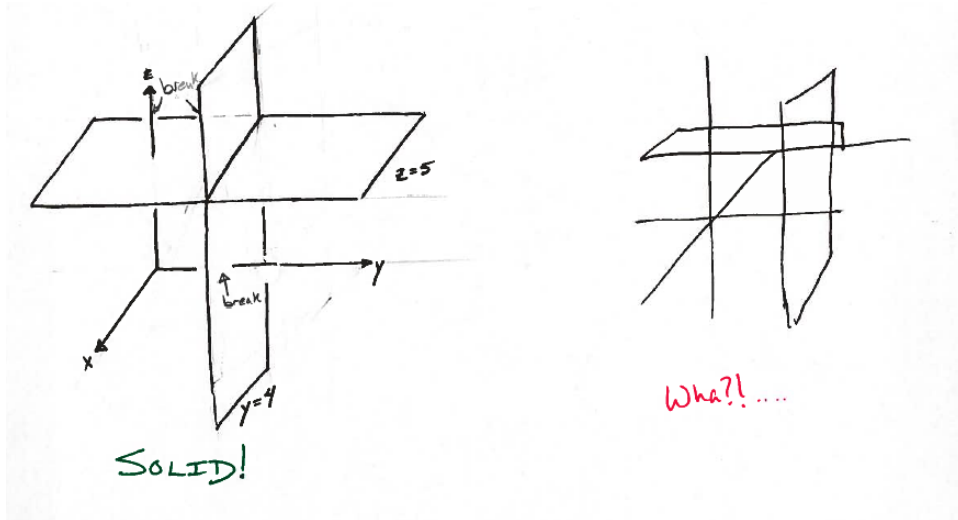
4. How can we convey the concepts of "behind", "above", or "below"? We can use *breaks*.



5. For the coordinate axes, make the angle between the positive x -axis and positive y -axis large enough. Try to have the angle between the positive z -axis and the positive y -axis be 90.



6. Draw planes that are *parallel* to the coordinate axes as though they are *rectangles* which have sides *parallel* to appropriate axes.



7. To draw a plane that intersects *all three axes*, try the following:

(i) Draw (tightly) the coordinate axes & mark the intersections.

Then connect 2 of the 3 intercepts with lines.

(ii) Complete this to a parallelogram (in pencil still!)

(iii) Expand this parallelogram a bit & use breaks to emphasize the resp. depth. Keep those intersection points! Keep those initial two lines! (Maybe include the third?)

NOT TOO SHABBY!

Helpful or not?

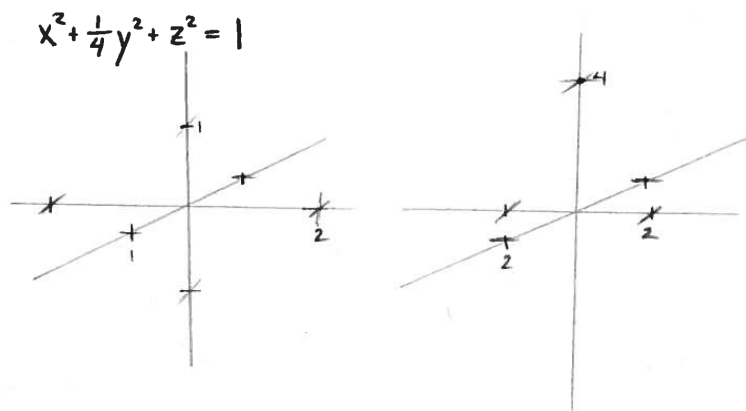
$x+2y+2z=2$

$x+2y+2z=2$

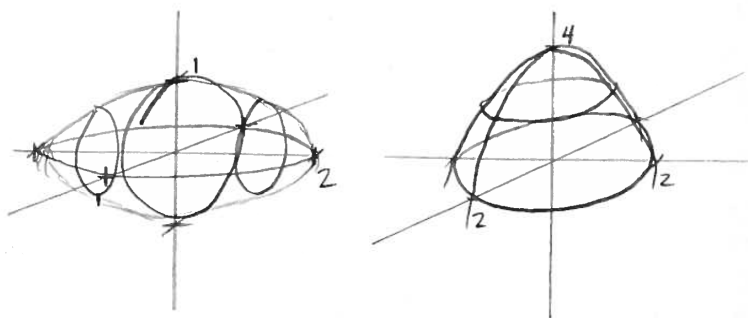
$(2,0,0)$, $(0,1,0)$, $(0,0,1)$

Here are some tips for drawing Quadric Surfaces

1. Lightly sketch the coordinate axes, then mark the intercepts.



2. Sketch some cross sections in the coordinate planes and possibly in a few parallel planes.



3. Darken the exposed sides and erase the parts of the axes that are not exposed. Use line breaks as needed.

